

REMARKS

In the parent application, independent claims 1 and 9 were rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103 as obvious in view of WO 9834755. The Examiner argued that the present application claims a Pb-free Sn based solder composition with Ag and Cu upper limits about the same as the lower limits of the '755 reference. The Examiner further acknowledged that '755 publication does not disclose the dissolution rate, liquidus temperature or viscosity of the present invention. The Examiner argued, however, that the claimed Pb-free Sn solder compositions overlap the reference and that, therefore, the material properties set forth in the claims would have been inherently possessed by the solders taught in the reference. Thus, the Examiner argued that the burden is on the applicants to prove that the prior art product does not inherently possess these characteristics. Applicants respectfully traverse this rejection.

As seen from claim 1 of the '755 reference, the solders have an eutectic melting temperature (i.e., solidus temperature) of about 217°C, and specific concentrations of Sn, Ag, and Cu deviate from the eutectic composition (i.e., about 93.6 wt.% of Sn, about 4.7 wt.% of Ag, and about 1.7wt.% of Cu) to provide a controlled melting temperature range not exceeding about 15°C above the melting temperature.

Moreover, as seen from claims 3 and 6 of the '755 reference, which are dependent on claim 1, the solders consist essentially of the following eutectic compositions:

Claim 3:

Ag: about 3.5 to 7.7 wt.%
Cu: about 1.0 to 4.0 wt.%
Ni: about 0.5 wt.% or less
Fe: about 0.5 wt.% or less
(Ni + Fe): about 1.0 wt.% or less
Sn: balance

Claim 6:

Ag: about 3.0 to 4.0 wt.%
Cu: about 0.5 to 4.0 wt.%
Ni: about 0.5 wt.% or less
Fe: about 0.5 wt.% or less
(Ni + Fe): about 1.0 wt.% or less

Sn: balance

In the discussion which follows, applicants refer to the composition of the solder disclosed in claim 3 of the '755 reference (Ag about 3.5 to 7.7 wt.%; Cu about 1.0 to 4.0 wt.%) as the "prior art solder 1". The applicants also refer to the composition of the solder disclosed in claim 6 of this reference (Ag about 3.0 to 4.0 wt.%; Cu about 0.5 to 4.0 wt.%) as the "prior art solder 2."

Claims 1 and 9 have been amended in the current application to avoid any overlap between the invention as claimed with that disclosed in WO 9834755. More particularly, it is noted that the range of Ag is outside of that of the solder disclosed in the '755 reference.

It is further noted that a Rule 132 Declaration is submitted herewith establishing the patentability of the invention over the '755 reference. As can be seen in the Declaration, the following combinations were examined:

Ag: 3	Cu: 0.5
Ag: 3	Cu: 4
Ag: 3.5	Cu: 1
Ag: 3.5	Cu: 2.5
Ag: 4	Cu: 0.5
Ag: 4	Cu: 1
Ag: 5.5	Cu: 2.5
Ag: 7.7	Cu: 1
Ag: 7.7	Cu: 4

Fe: 0.1, 0.5

Ni: 0.1, 0.5

Co: 0.1, 0.5

Fe + Ni + Co: 0.1 + 0.1 + 0.1

Fe + Ni + Co: 0.3 + 0.3 + 0.3

Accordingly, 72 samples were examined in total, as to the liquidus and solidus temperatures, cooper dissolution rate, and viscosity. In these tests, the solidus temperature was set at 217°C for all of samples 1-72, in accordance with claim 1 of the '755. reference.

In the evaluation of Samples 1-72, it should be noted that:

A. As to the liquidus temperature, if it is over 240°C, the samples are judged “bad.” If it is equal to 230°C or lower, the samples are judged “good.” If it is between 230°C to 240°C, the samples are judged “not so bad.”

B. As to copper dissolution rate, if it is over 0.15 $\mu\text{m}/\text{sec}$, the samples are judged “bad.” If it is less than 0.15 $\mu\text{m sec}$, the samples are judged “good.” If it is between 0.15 $\mu\text{m sec}$ to 0.20 $\mu\text{m sec}$, the samples are judged “not so bad.”

C. As to the viscosity, if it is over 2.5 cP, the samples are judged “bad.” If it is equal to 2.5 cP or lower, the samples are judged “good.”

(a) Samples 1 to 8 corresponding to the lead-free solder of the invention contain:

Ag	3 wt.%
Cu	0.5 wt.%
Solidus Temperature	217°C
Liquidus Temperature	<230°C

In these samples, the liquidus temperature is lower than 230°C, the copper dissolution rate I is lower than 0.15 $\mu\text{m}/\text{sec}$, and the viscosity is lower than 2.5 cP. These samples thus exhibit the advantages of the lead-free solder of the invention.

(b) Samples 9 to 16, which fall outside of the amended claims and correspond to solder 2 of the WO 9834755 reference:

Ag	3 wt.%
Cu	4 wt.%
Solidus Temperature	217°C
Liquidus Temperature	>>230°C

The Ag composition is kept at 3 wt.%, the Cu composition is kept at 4 wt.%, and the solidus temperature is set at 217°C. These samples correspond to the prior-art solder 2. In these samples, the liquidus temperature is much higher than 230°C. Therefore, these samples do not exhibit the advantages of the lead-free solder of the invention.

(c) Samples 17 to 24 correspond to both of the prior art solders 1 and 2:

Ag	3.5 wt.%
Cu	1 wt.%
Solidus Temperature	217°C

In these samples, although the copper dissolution rate is lower than 0.15 $\mu\text{m}/\text{sec}$, the liquidus temperature may be lower or higher than 230°C, and the viscosity maybe lower or higher

In re Appln. of Toshihide ITO et al.
Application No. 09/671,084

than 2.5 cP, depending on the amount of Fe, Ni, or Co added. Therefore, according to the above standards, only samples 19, 21 and 23 are good and the remainder are bad. In other words, although the copper dissolution rate is lower than 0.15 $\mu\text{m}/\text{sec}$, the liquidus temperature may be lower or higher than 230°C, and the viscosity may be lower or higher than 2.5 cP, dependent on the amount of Fe, Ni, or Co added intentionally. This means that these advantages are not always obtainable by limiting these compositions. In other words, the periphery of the composition(s) of Fe, Ni, and/or Co is not well defined.

Therefore, samples 17-24 are technically different from the lead-free solder of the present invention.

(d) Samples 25 to 32 correspond to both of the prior art solders 1 and 2:

Ag	3.5 wt.%
Cu	2.5 wt.%
Solidus Temperature	217°C

In these samples, the liquidus temperature is much higher than 230°C. Therefore, these samples do not exhibit the advantages of the lead-free solder of the invention.

(e) Samples 33 to 40 correspond to the prior art solder 2:

Ag	4 wt.%
Cu	0.5 wt.%
Solidus Temperature	217°C

In these samples, although the copper dissolution rate is equal to or lower than 0.15 $\mu\text{m}/\text{sec}$, the liquidus temperature may be lower or higher than 230°C. and the viscosity may be lower or higher than 2.5 cP, depending on the amount of Fe, Ni, or Co added.

(f) Samples 41 to 48 correspond to both of the prior art solders 1 and 2:

Ag	4 wt.%
Cu	0.5 wt.%
Solidus Temperature	217°C

In these samples, although the copper dissolution rate is equal to or lower than 0.15 $\mu\text{m}/\text{sec}$, the liquidus temperature may be lower or higher than 230°C, and the viscosity may be lower or higher than 2.5 cP, dependent on the amount of Fe, Ni, or Co added intentionally.

(g) Samples 49 to 56 correspond to the prior art solder 1:

Ag	5.5 wt.%
Cu	2.5 wt.%

Solidus Temperature 217°C

In these samples, the liquidus temperature is much higher than 230°C. Therefore, these samples do not exhibit the advantages of the lead-free solder of the invention.

(h) Samples 57 to 64 correspond to the prior art solder 1:

Ag	7.7 wt.%
Cu	1 wt.%
Solidus Temperature	217°C

In these samples, the liquidus temperature is much higher than 230°C. Therefore, these samples do not exhibit the advantages of the lead-free solder of the invention.

(i) Samples 65 to 72 correspond to the prior art solder 1:

Ag	7.7 wt.%
Cu	4 wt.%
Solidus Temperature	217°C

In these samples, the liquidus temperature is much higher than 230°C. Therefore, these samples do not exhibit the advantages of the lead-free solder of the invention.

In summary, the results obtained in the testing described in the accompanying Rule 132 Declaration establishes that the following solder compositions in accordance with the present invention had satisfactory solder characteristics:

Sample Nos.	Ag	Cu
1-8	3	.5
17-24	3.5	1
33-40	4	.5
41-48	4	1

In contrast, the following compositions which follow the teaching of the '755 publication produced an unsatisfactory solder composition:

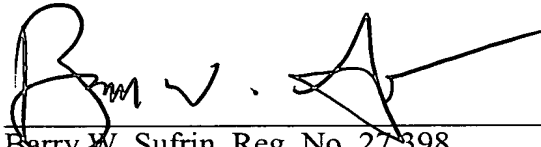
Sample Nos.	Ag	Cu
9-16	3	4
17-24	3.5	1
33-40	4	.5
41-48	4	1
25-32	3.5	2.5
49-56	5.5	2.5
57-64	7.7	1
65-72	7.7	4

In re Appln. of Toshihide ITO et al.
Application No. 09/671,084

This data is believed to demonstrate that the cited prior art does not inherently and consistently possess the characteristics attributed to the present composition, as set forth in the amended claims.

Accordingly, the present application is considered in good and proper form for allowance, and the Examiner is respectfully requested to pass this application to issue. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Barry W. Sufrin', is written over a horizontal line.

Barry W. Sufrin, Reg. No. 27,398
MICHAEL BEST & FRIEDRICH, LLP
401 North Michigan Avenue
Suite 1900
Chicago, Illinois 60611
(312) 222-0800 (telephone)
(312) 222-0818 (facsimile)

Date: November 26, 2003

S:\client\200335\0037\C0277146.1
11/26/03